# Momentum:

- vector quantity
- defined as (mass)(velocity)
- force that keeps obj. in motion
- always conserved in collisions
- $F\Delta t$ (can say in words)
- how much movement there is of matter
- "I bet there's a law." -Albert

- Definition:

$$\bar{p} = m\bar{v}$$

Units of $\bar{p}$: $kg \cdot m/s$

- aside: $\sum \bar{F} = \frac{d\bar{p}}{dt}$

N2: $\sum \bar{F} = m\bar{a}$

- Conservation:

- In an isolated system, momentum is conserved.

$$\bar{p}_i = \bar{p}_f$$

for 2 objects: $m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$

- Impulse:

$$\bar{J} = \bar{F}\Delta t$$

units: $kg \cdot m/s$

- Relationship with momentum:

$$\bar{J} = \Delta\bar{p}$$ Impulse-Momentum

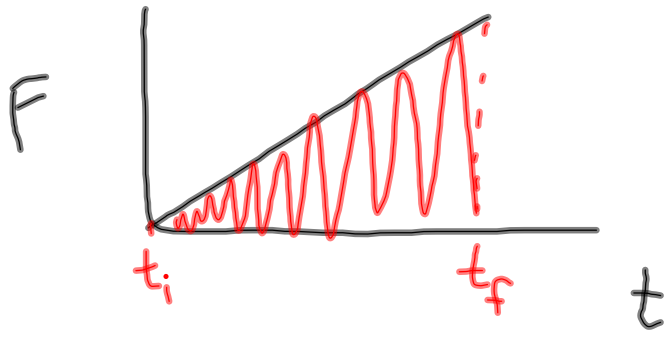
$$\bar{F}\Delta t = \Delta\bar{p}$$ theorem

# Implications of Impulse-Momentum thm:

- Kinematics eqn. w/mass
- How much obj. lost/gained $\vec{p}$
- Used to solve for variables

- Airbags

- Graphs:




$$\text{Area} = F(t_f - t_i) = F\Delta t$$

$$= J = \Delta p$$

A 60 kg archer stands at rest on frictionless ice and fires a 0.50 kg arrow horizontally at 50 m/s. With what velocity does the archer move across the ice after firing the arrow?

$$\bar{p}_{archer} = \bar{p}_{arrow}$$

another way to write:

$$\bar{p}_{archer} + \bar{p}_{arrow} = 0$$

$$m_{arch}\bar{v}_{arch} = m_{arr}\bar{v}_{arr}$$

$$\bar{v}_{archer} = \frac{m_{arr}}{m_{arch}}(\bar{v}_{arr})$$

$$= \frac{(.5\ kg)}{(60\ kg)}(50\ m/s)$$

$$= .417\ m/s$$

in the opposite direction